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## THE ANATOMY OF DICOTYLEDONS.

*Systematic Anatomy of Dicotyledons: a Handbook for Laboratories of Pure and Applied Botany.* By Dr. H. Solereder. Translated by L. A. Boodle and Dr. F. E. Fritsch. Revised by Dr. D. H. Scott. Vol. I., Introduction, Polypetalæ, Gamopetalæ. Pp. xii+644. Price 24s. net. Vol. II., Monochlamydeæ, Addenda, Concluding Remarks. Pp. vi+645 to 1182. (Oxford: The Clarendon Press, 1908.) Price 24s. net.

THE long-expected translation of Dr. Hans Solereder's "Systematische Anatomie der Dicotyledon," which has recently been issued by the Clarendon Press, is the latest addition to the splendid series of English translations of classical German works for which all English-speaking people owe a deep debt of gratitude to the Oxford Press.

Except for the introduction and for the "concluding remarks," which appear at the end of the second volume, Dr. Solereder's work cannot be recommended for a course of continuous reading. As a work of reference, however, and as an exhaustive guide to the literature of the anatomy of Dicotyledons, the book will be found to be invaluable. Under each natural order the vast amount of material to be dealt with is arranged according to a common plan; a review of the anatomical features is first given, this is then followed by an account of the structure of the leaf, the subject being subdivided under the epidermis, stomata, internal structure, crystals, hairs, glands, and the structure of the petiole. The structure of the axis forms the third division, which is subdivided according to the peculiar needs of each natural order. Some account is also given of any anomalous or remarkable structures, and finally a complete list of the literature, brought, so far as possible, up to date, is placed at the end of each order.

One hundred and fifty-three figures in the first volume and thirty-six in the second are scattered through the text to illustrate typical or peculiar anatomical features in the various orders or genera. It would clearly be impossible to attempt to review or to criticise in detail the vast mass of material which has been compressed into the pages of these volumes, for the value of the book can only become apparent to anyone actually working in the laboratory at the comparative anatomy of a natural order or a group of genera.

Dr. Solereder's work will occupy much the same position as a work of reference for the morphological botanist as the "Index Kewensis" does for the pure systematist. One looks through its pages in the hope of finding that some light may be shed on complicated taxonomic problems, only to be disappointed. Dr. Solereder's book, however, serves as the key by which the door may be opened by both the plant anatomist and taxonomist to a common field of fruitful investigation. It is somewhat remarkable to notice the extent to which anatomical research tends to confirm the conclusions of the systematist, as, for instance, in

the Loganiaceæ; all the genera of the Loganioideæ are found to have bicollateral vascular bundles, whilst all the Buddleioidæ have simple collateral bundles. Further, in the allied order Gentianaceæ, bicollateral bundles are characteristic of practically all the representatives with the exception of the Menyantheæ. As to the affinities of some of the orders, the position of which is uncertain, as, for instance, the Coriariaceæ, little further light, unfortunately, is shed by the anatomical method. On the other hand, the method may be of great service in the case of assigning a peculiar genus to its proper position in the natural system. The genus *Chalepoa*, for example, which had been placed with the Pittosporæ, has been transferred to the Saxifragaceæ, owing to the absence of the resin canals characteristic of Pittosporæ.

A yet more interesting case of the service which can be rendered to systematic work by the anatomical method was afforded some years ago by Radlkofer (British Association Report, Aberdeen, 1885), when he was attempting to determine some of the fragmentary material in old herbaria. From an examination of *Sideroxylon mite*, L., in the Linnæan herbarium, it was found that this plant did not belong to the Myrsineaceæ, as suggested by Sprengel, who named it *Myrsine mitis*, Spreng., but was in reality a specimen of *Ilex capensis*, Sond. Another supposed species of Myrsine, *M. marginata*, Hook. et Arn., was found, from the examination of a fragment of the plant, to belong to the Sapotaceæ, and to be a specimen of *Chrysophyllum marginatum*. Unfortunately, Solereder has misquoted these facts in his book (p. 508, footnote 1), and refers *M. mitis* to the Sapotaceæ and *M. marginata* to the Illiciaceæ.

In the second volume the Monochlamydeæ occupy the first 158 pages; these are followed by 264 pages of addenda to the various natural orders, and the remainder of the volume is occupied by the concluding remarks (98 pages), a literature supplement embodying the latest papers, a brief index, and a glossary. It is of interest to notice, among other points, that on anatomical evidence the natural order Basellaceæ established by Moquin-Tandon is maintained as a distinct order from the Chenopodiaceæ.

In the concluding remarks the various characters which may be used in the anatomical method are passed in review under seven headings or chapters, and this summary is intended to serve as an aid in the determination of a plant by means of its anatomical characters. The seven subdivisions are:—(1) Structure of the lamina of the leaf; (2) structure of the petiole; (3) secretory and excretory receptacles; (4) hairy covering; (5) normal structure of the axis; (6) anomalous structure of the axis; (7) structure of the root. The treatment of the subject in these chapters is of a very exhaustive nature, and, so far as can be seen, every structure of importance in any part of the plant is carefully and systematically dealt with.

Dr. Solereder makes an earnest appeal to systematists to make use of the anatomical method so far as possible when publishing new genera and new species. In time, no doubt, this will be done, but at present the amount of material requiring careful and critical examination in our herbaria is so great, and

the work involved in the systematic adoption of the anatomical method is so enormous, that it seems hardly likely that great progress will be made in this direction for some time to come.

The value of chemical substances in the plant is also emphasised for helping to establish points of affinity, though cases do occur in which similar substances of a peculiar nature are found in quite unrelated plants. One of the difficulties of the method lies in making the choice of those anatomical characters which may prove to be of systematic importance. It is clear that characters, which are ancestral rather than adaptive, will be of most value from the taxonomic point of view. The value of an anatomical character, however, cannot be predicted, and at times exceptions will be found to a character which appears to be otherwise typical of the particular group or order. Much light may be expected to be thrown by the anatomical method as to whether certain features in a plant are to be regarded as ancestral or adaptive from a comparison with other closely allied plants; and it may be noted in passing that careful work in this direction is being done on the anatomy of seedlings in this country. A word of warning, however, is necessary, which is not forgotten by the author, to those adopting the method, since it is not yet known whether a given character may be constant in a single species under different conditions of cultivation. The tea-plant, for instance, may or may not possess spicular cells in the leaf.

Dr. Solereder concludes his excellent and interesting introduction with a summing up of the possibilities of and warnings against the dangers of the anatomical method. It only remains to praise most highly the way in which Messrs. Boodle and Fritsch, under the careful editorship of Dr. Scott, have carried out the very arduous work of translating a volume, every page of which seems scarcely large enough to contain the solid and pregnant matter with which it is crowded.

A word of thanks must be added to Dr. Fritsch for the glossary at the end of the second volume, in which the chief terms used in anatomical description are defined, or a reference to a definite passage in the work is given where such terms are explained. In most cases the German equivalents of the terms are given, making the glossary of considerable value.

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#### PROBLEMS OF THE PAPER MILL.

*Chapters on Paper-making.* Vol. v., Concerning the Theory and Practice of Beating. By Clayton Beadle. Pp. vii+182. (London: Crosby Lockwood and Son, 1908.)

THIS is a record of observations incidental to an analytical study of the process of "beating" in the paper mills, the process by which the fibrous raw materials are prepared, by wet milling, for the actual paper-making operations. The central importance of the beating process is generally recognised; it is also evident that it is a highly complex operation. The purpose of this volume is to suggest to paper-makers

what are the factors of the result, and how they may be effectually studied by way of observations which can be recorded in terms of numbers.

The author's observations are in the main those of mechanical energy consumed in the various stages of beating, *i.e.* in the "breaking in," the "beating" proper, and in "refining."

Beaters of the various types have been analytically studied, and the results are discussed in reference to the general structural details of the machines themselves, as well as of the main working parts, that is, the roll and the bed-plate. The main purpose is to establish their relative economy and efficiency. Thus the Hollander is generally contrasted with the more modern types of beaters, *e.g.* the "Reed," the "Taylor," and the "Tait engine," and the separated operations of "refining" in such engines as the "Kingsland" or "Jordan." Chapter x., on "the relative merits of stone and metal beater bars," is a useful contribution to progressive problems.

The author generally avoids drawing positive conclusions in view of the fact that efficiency, or the integral result of the preparation, involves those still obscure factors of condition, that is, the relation determined between the beaten fibres and the watery medium in which they are carried in suspension, to be compacted into the wet web on the wire of the paper machine or mould. This is the subject-matter of a special chapter (chapter xvii.), which records the results of experiments in the grading or fractionation of pulps by dry or wet methods, the former giving results according to dimensions, the latter introducing the complicating factor of "hydration" or "wetness."

The book is certainly a record of progress in the technology of paper-making. It emphasises the criticism which paper-makers make on the realistic tendencies of our technical schools. A "model" paper-making plant, such as has been installed at the Manchester School of Technology, is so far illusive in its realism that a "model beater" is not a representation to scale of the working conditions of the ordinary engine; and as the beating process constitutes the essential preparation of pulps, the educational result of a model mill is weakened by the implication of an incorrect perspective.

Contrariwise, the author's observations suggest an individuality or idiosyncrasy of beating engines, and this degree of unconformity to type entails special study of each machine in work, which study may be purely empirical or may be based upon selective quantitative investigations of the essential factors.

The technical records of this book are intended to serve as models of such investigations in the mill.

The educational value of this volume is weakened by its method or want of method. The author trusts his matter to evolve its own logical form and cohesion, wherein he so far abdicates the privileged position of teacher, which is to be didactic even when some risks have to be taken in stating conclusions; this is necessary to awaken and sustain the interest of the student.

The matter would be much improved by a clear *exposé* of principles, and the contributory factors of